APPLICATION GUIDE FOR TRUNK CARRIER SPECIFICATIONS REA FORM 397b

Purpose: The purpose of this addendum is to clarify certain items in the REA Form 397b and to offer some suggestions in being more specific in your carrier system requirements.

ADDITION:

1. GENERAL

1.1 The REA Form 397b was last revised in December 1971. It provides flexibility to serve the needs of a wide variety of telephone company carrier system needs. For the 397b to be thorough and complete, many specific details of the system requirements must be outlined in addenda and in blanks in Part IIIA. Be complete in detailing your specific requirements so that the quotations from carrier sellers are made on comparable equipment quantities.

1.2 Since the Form 397b was issued in December 1971, several questions have been raised concerning the exact intent of some items. Clarification of these items and some recommendations are offered for use in specifying trunk carrier equipment.

1.3 The Purchaser should include a short narrative describing the proposed trunk service. This can help to clarify the specific system requirements and supply a tenative timetable for present and future requirements. The Seller should also include a short narrative to describe the proposed system and its component parts, accessories, options and necessary test equipment. It should include a plan for orderly growth from the proposed initial quantities to the required ultimate quantities of equipment.

1.4 PCM carrier terminals and span line equipment are now listed separately on the REA List of Acceptable Materials. Span line transfer systems are expected to be evaluated and shown separately in the near future. If PCM terminals, span lines and span line transfer systems are purchased from different Sellers, the Purchaser should outline the equipment required and the responsibility of each Seller. Separate specifications should be prepared for terminals, span lines and span line transfer systems if these are to be purchased from different Sellers.

2. CLARIFICATION AND RECOMMENDATIONS

2.1 Item 1.13 of Part II of the 397b requires protection on all cable pairs that are "connected" into the repeater cabinet. This might be interpreted as order wire and interrogation pairs plus initial systems or ultimate systems. The Seller may have no way of knowing how many pairs are "connected". Be specific in your protection requirements.

2.11 The original intent was to protect the initial carrier repeaters, interrogation, etc., and also those pairs that would "soon" be needed to add repeaters (those pairs "connected"). This way, repeaters could be added without the concern that those pairs might not be protected. Some telephone companies question this practice of providing protection before it is needed because of the cost. Assess your system growth rate expectations. Specify protection requirements to suit your system needs. Be sure that when repeaters are added later that they are always applied to protected cable pairs. A chart similar to the following is suggested to clarify the required gas tubes for each repeater housing.

Equipment or Cable Quantities		Pairs Requiring Protection
Repeaters to be protected	_____	_____
Order Wire Pair	_____	_____
Fault Location Pairs	_____	_____
Additional Pairs	_____	_____
Total Pairs		_____

(Note: Protection is required for each repeater input and output pair. For instance, four pairs require protection for each N or T type repeater. Most other pairs are bridged through a repeater housing.

2.2 Item 2.021 of Part IIIA asks if repeater housing stubs are required (yes or no). To avoid a misunderstanding at a later time, specify the minimum pairs required, stub length, and manufactured to a specific REA cable specification. State other stub requirements in specific terms. Compartment or screen type stubs are recommended. (Note: If the stub requirements are not specifically stated, stubs may be supplied that differ slightly from the telephone company's installed cables. Carrier equipment manufacturers often use standard cable stubs to avoid stocking several different types, and may take exception to some of the stated cable stub requirements.)

2.21 There are a variety of housings offered by the carrier equipment suppliers. These units vary in cost, construction materials, pressurized versus non pressurized, and ease of entry for maintenance. The Purchaser should note the preference or exclusion of any types of housings.

2.3 Item 2.04 of Part IIIA asks if a common power supply is required. The intent here refers to span line power supplies where several span lines are powered from one common supply. This is not intended to refer to PCM channel bank power supplies. Automatic power transfer can consist of a simple diode or relay arrangement. (Note: In many cases, each span line is powered by a separate supply deriving power from the central office battery.)

2.4 Item 2.07 of Part IIIA asks if a spare span line transfer system is required (yes or no). Spare span line transfer systems range from simple, low cost switches to complex and sophisticated systems at higher costs. Review your system requirements and if automatic transfer is required, state in detail your needs for automatic span line transfer and restoral. (Refer to TE&CM Section 950 for additional information and recommendations.)

2.5 Item 2.13 of Part IIIA refers to 51.6 V dc and other power. A battery filter external to the carrier equipment may be required to meet system requirements for noise, etc. It is the Seller's responsibility to supply the necessary filtering to meet the requirements of paragraph 3.2 of PE-60. If the battery noise exceeds 40 dBrn C-message weighted or 65 dBrn-3kHz flat, it is the Purchaser's responsibility to supply the additional filtering, unless such requirements are stated in the specifications.

2.6 Item 3.1 of Part IIIA states the channel net loss requirements. The voice frequency levels to accomplish the channel net loss should be outlined in detail in Addenda under Item 7.16. These levels depend on net loss and such things as 2 dB test pads incorporated in test boards of some toll centers. The exact level values should be stated in the diagram after consultation with the connecting company.

2.7 Item 3.02 of Part IIIA states idle channel noise requirements. This will usually require consultation with a connecting company. Noise requirements vary with different connecting companies and type of carrier equipment; and may be affected by toll test board 2 dB test pads.

2.8 Item 5.1 should be completed in detail along with more complete cable information in the "Carrier System Layout" (Addenda under Item 7.11). Plans and specifications are incomplete without detailed cable and layout information.

2.9 Item 5.2 is to show that the Carrier Seller or Telephone Company will make measurements on the outside plant. In earlier years, cable test equipment for carrier use was specialized. There is a variety of test equipment available today. The telephone company or consulting engineer must test the outside plant before the plans and specifications are sent to carrier suppliers for quotations. Be sure that existing outside plant is suitable for carrier application before purchasing large quantities of equipment to be operated over these existing facilities. Refer to REA TE&CM Section 921 entitled, "Testing Cables For Carrier Application".

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1. GENERAL

1.1 This section provides REA borrowers, consulting engineers, carrier equipment manufacturers and sellers with technical information concerning the use of REA Form 397b, "Trunk Carrier Specifications."

1.2 Part IIIA of REA Form 397b provides a form for furnishing carrier requirements and application information to the carrier seller in procuring carrier equipment. Part IIIB is the seller's proposal and is filled out by the seller.

1.3 Part IIIA is designed for new system installations and complete system additions. If there is to be expansion of existing systems or rearrangement of existing systems, the engineer should design his own form to fit the circumstances encountered.

2. PART IIIA, REA FORM 397b

2.01 The purpose of Part IIIA of the Trunk Carrier Plans and Specifications is to present application engineering data to the carrier equipment sellers in a form such that the most important items have been considered. The purchaser or his engineer shall prepare the plans and specifications. The individual items of Part IIIA are discussed in order of appearance. Since many items in Part IIIA are self-explanatory, no discussion is included for these items.

2.02 In Item 1 the names of the central offices at which each terminal of the carrier systems will be located shall be completed here. If more than two locations are involved, reference should be made to the "Carrier System Layout" or an appropriate notation included in Item 1. It also includes space to indicate if the seller will install the equipment or if the purchaser will perform the installation.

2.03 In Item 2 a "Carrier System Layout" is required. This drawing is an integral part of the trunk carrier plans and specifications and the specifications are incomplete without such a layout. The engineer

preparing the layout should use his ingenuity to best display the proposed system in those projects where the layout is complex. The following outline is a guide for the minimum information which should be included in the layout:

2.0301 All of the existing and proposed central offices involved with this equipment together with the toll center or other connecting company outlets in a given area.

2.0302 The number of trunks between central offices in order to meet the initial requirements proposed. This includes physical and carrier derived trunks for toll, extended area service usage, special service, etc. The ownership of the physical plant and the carrier equipment on connections with connecting company facilities should be shown on the "Carrier System Layout." If rearrangement of existing facilities is involved, a separate layout should be provided showing the existing facilities.

2.0303 The estimated number of physical and carrier derived trunks which will be required along each route for the ultimate requirements. This is necessary so that the type of carrier system and wire facilities initially employed shall provide the required system growth in an orderly and economic manner.

2.0304 The number of station carrier circuits existing or planned from each central office which would be provided in the same cables or open wire routes.

2.0305 The length, type, size, gauge, etc., of all cable and/or open wire facilities between carrier terminals and between carrier repeaters. List nominal cable capacitance. Repeater spacing is specified by the purchaser when it is necessary due to meeting connecting company agreements and also where repeater cabinets are existing. Otherwise the seller should specify repeater spacings.

2.0306 For open wire application the type of transposition system, average span length, type and gauge of conductor, age of conductor, length of entrance cable, length of intermediate cable inserts and pin positions of circuits over which the carrier equipment will operate.

2.0307 The distance of shared facilities with other carrier systems between central offices of both trunk and subscriber carrier systems.

2.0308 Central offices where tandem switching of trunk circuits on a voice frequency basis is occurring or will occur in the future are indicated.

2.0309 The type and routes of any other carrier system in the area are shown if information is available. This includes carrier systems of other telephone companies on routes where the borrower rents pin space, telephone and power line carrier systems of other utilities, etc.

2.0310 Where it is necessary to meet impulse noise objectives by use of separate trunk cables or separate toll entrance cables, such facilities should be shown on the "Carrier System Layout" and appropriate notes should be included to describe those facilities which are provided for this reason.

2.0311 It is not intended that the information contained in the "Carrier System Layout" be a duplication of the information required in Part IIIA. Preferably the details should be stated in Part IIIA as requested; however, the engineer may choose to include all or some of the details on the drawing rather than specify it in Part IIIA. When this is done, a notation in the blank spaces of Part IIIA should refer to the layout drawing.

2.04 In Item 2.02 careful consideration is given to the ultimate number of systems specified since in most type carrier systems the spacing of repeaters depends on the system density in a cable. The capacity of the repeater housing should be equal to the ultimate number of systems of the route unless the growth is slow and smaller size housing would be adequate for a ten year period.

2.041 In Items 2.022 through 2.07 PCM span line equipment is specified. Among the items considered are: (1) automatic repeater equalization, (2) spare span lines, (3) spare span line patching jacks, (4) span line interrogation system, and (5) automatic spare span line transfer system.

2.05 In Item 2.08 the method of signaling should be left to the carrier seller. Many carrier systems contain built-in signaling systems which are reliable and would not cost extra. All PCM type carrier systems, for example, come with built-in signaling systems. If it is necessary to specify the method of signaling, space is provided in this item to do so. It should only be necessary to specify the method of signaling when it is necessary to coordinate with the signaling planned by a connecting company. The 2600 Hz inband signaling system may be necessary to coordinate with the connecting company. This type signaling should be avoided if possible because it is very costly in initial investment and in annual maintenance.

2.06 In Item 2.09 the number and type of signaling termination is specified on the table provided. Definite savings can be made by using one-way loop dial carrier trunks where possible instead of E and M type trunks because there is no need to provide E and M trunk circuits in the central office equipment for most types of one-way loop

dial carrier trunks. One-way loop dial trunks should be considered where a large number of trunks are involved between exchanges and it is practical to divide the traffic by direction of signaling. One-way loop dial signaling would not usually be considered where the number of trunks in the group is small as much better traffic efficiency is obtained with two-way signaling.

2.061 In Item 2.091 is specified the requirement for A and B leads on E and M signaling terminations for the carrier channels where no VF extensions are required. Figure 1 is a simplified drawing of E and M signaling which indicates a common method of deriving A and B leads when E and M trunk circuit is connected to a coil type hybrid. When a resistance type hybrid is used instead of a coil type, A and B leads can be derived as shown in Figure 2 by using coils to isolate the pulsing relay from the voice frequency transmission path. Either coil or resistance type hybrids can be used with carrier systems and meet all transmission requirements. The carrier supplier will derive the A and B leads where they are specified. A and B leads should not be derived by using repeating coils. It is intended that by specifying the need for A and B leads as part of the hybrid supplied by the carrier seller, the use of repeating coils will not be required. In this way improved echo return loss and singing point values should be possible and the insertion loss due to repeating coils is eliminated. It is important that the engineer preparing the carrier equipment plans and specifications coordinate the trunk equipment from the central office equipment supplier with that of the carrier equipment supplier to avoid difficulties at time of cutover.

2.062 In Items 2.093 and 2.094 is specified the number of one-way loop dial signaling terminations for the carrier channels. One limitation on the use of one-way loop dial signaling exists where tandem offices are involved which switch to other one-way loop dial carrier channels. If this situation exists, the entire trunking arrangement must be clearly displayed in the "Carrier System Layout" and the extent of tandem switching noted so that the carrier supplier can select the proper equipment to apply. Another limitation involves using one-way loop dial trunks for dial operator trunks. Loop dial signaling should not be specified for dial operator trunks because the reverse battery supervision is incompatible with paystation operation. One-way loop dial trunks should not be specified for ANI trunks as a special ANI trunk circuit is required to perform the required ANI functions.

2.063 In Item 2.096 it is specified if the carrier supplier is to provide all trunk busy or peg count lead connections to the central office meters from each one-way loop dial trunk. REA's PE-60, "Trunk Carrier Multiplex Equipment," provides for ATB and peg count signal leads from each one-way loop dial originating carrier

channel; however, a definite requirement has to be specified here because the carrier supplier has to provide the wiring to metering equipment external to the carrier channels and he must know which trunks are to be included in the group to be metered.

2.07 In Item 2.10 the details of the voice frequency and signaling connection to the central office equipment are specified. Two columns are provided, one for each terminal of the carrier system. If the plans and specifications are for both terminals of the equipment, both columns must be filled in completely. It should be noted that there is no provision on these forms to specify external four wire terminating sets. The use of external four wire terminating sets is discouraged because carrier channels can usually be procured with a built-in hybrid for little or hardly any extra cost. This saves the cost of the terminating set. If it is necessary to provide for external terminating sets such as when connecting to a voice frequency extension, this requirement shall be specified in Item 2.107. It is recommended that it be left to the seller how he is to meet the requirements of Item 2.103.

2.071 In Item 2.102 the type of central office equipment to which the carrier equipment will connect is specified such as Stromberg-Carlson "XY" or ITT PC-32B, etc.

2.072 In Item 2.103 the central office impedance is specified. For a Class 5 office the impedance is 900 ohms. For a Class 4 office the impedance is 600 ohms. From this information the carrier supplier will furnish a voice frequency hybrid for the carrier equipment which has the correct terminal impedance. If a hybrid with the wrong terminal impedance is installed, it will seriously degrade the return loss and singing point as seen looking into the carrier terminal. It will also mean that echo return loss and singing point objectives as required on toll connecting trunks will not be met.

2.073 In Item 2.104 the actual central office equipment circuit number for the E and M trunks is specified. The importance of this information should not be minimized because, if stated in the plans and specifications, it is the carrier seller's responsibility to provide compatible equipment that will perform satisfactorily with the central office equipment.

2.074 In Items 2.105 and 2.106 the actual circuit numbers of the incoming and outgoing selectors of the central office equipment shall be specified here. Example: W.E. SD 31779-01. This is important because some types of loop dial arrangements are on a two-wire basis while others are of the three-wire type.

2.075 Item 2.107. It is not convenient to show detailed engineering plans in a form for special applications such as four-wire,

back-to-back interconnection of carrier systems or voice frequency extensions off of a carrier channel. Such applications should be detailed in specially prepared plans which clearly specify what equipment the carrier supplier has to furnish. In general, carrier back-to-back arrangements are not recommended and should be avoided if economically possible.

2.08 Item 2.11 a general description should be provided of the toll ticketing, automatic number identification and switching equipment which will operate in connection with the carrier equipment furnished. For example, on some automatic toll ticketing equipment it is necessary to transmit signaling information during a portion of the time when conversation may also be taking place over the trunk. For this type of toll ticketing equipment, inband signaling over carrier channels would not be compatible.

2.09 Item 2.12. It is preferable that the carrier seller specify carrier repeater spacing rather than for the borrower or its engineers to specify the spacing. This is applicable where both terminals of a carrier system are being furnished by the seller and are within the borrower's system. On an interconnection arrangement with another company, it may be necessary to coordinate repeater spacing with the connecting company's engineering staff; in which case, the repeater spacing can be specified.

2.10 Item 2.13. Most transistorized carrier equipment is designed for 51.6V dc operation. Cable carrier systems that power repeaters at locations remote from the central office over the carrier frequency pairs may require a +130V, -130V or ±130V dc power supply. If the telephone company wants all carrier equipment powered from 51.6V central office battery, it should be specified in Item 2.131. Where a 130 volt dc power source is required, the seller can usually provide a 51.6V dc to 130V dc solid state converter. This is one of the most economical means for providing such a source for the small unattended rural exchange. Of course, where much carrier equipment is to be powered from the 51.6V central office battery, a check should be made to determine if adequate charger and battery reserve is available in the existing office. For large telephone exchanges a separate bank of batteries providing 130V dc power may prove more economical. The need for these batteries should be carefully studied. If the seller is to provide a fuse and alarm panel, the purchaser should specify that here.

2.101 Item 2.132. In large carrier equipment installations of other than those of PCM equipment dc power supplies for all carrier equipment could be supplied from one common supply. It may be desirable to specify a separate power supply with automatic transfer in the event of failure of the main supply which would place many carrier systems out of service. Or, individual supplies could be specified for one or two systems.

2.11 Item 2.14 provides for the purchaser to specify additional jack arrangements above the minimum requirements specified in PE-60 for trunk carrier equipment. A drawing should be completed by the engineer which indicates the number of VF, T&R, mod, demod, E&M, A&B lead lifting jacks facing the carrier. Further, it should include the number of each facing the central office equipment. Monitor jack requirements for each central office should also be shown. Jacks are indispensable for routine maintenance of carrier trunks and the telephone company should carefully consider its needs consistent with its maintenance practices.

2.12 Item 2.15 provides for specification of carrier system alarm circuitry such as may be required for alarm identification from an unattended office to an attended office through the central office equipment alarm system. For example, in the event of a carrier system failure which may be sensed by the carrier alarm circuitry by absence of receive power at a terminal or by other means, a major or minor alarm can be sent to an attended toll board or other location through the normal central office equipment alarm system. The alarm relay or other circuitry required between the carrier and the central office equipment to do this must be supplied by the carrier seller. The purchaser will also specify here if it will make the alarm connections or the seller will make the connections.

2.121 In specifying alarms within the carrier system and subsequent action thereafter, such as disconnect and make-busy features, it should be realized that most carrier equipment provides such features on a system basis rather than on an individual channel failure basis. The disconnect and make busy feature includes opening the "E" lead for a short period of time dropping the called party from the circuit. This time period allows the calling party to hang up before the channel is made busy. If a telephone company is unwilling to accept the alarm features normally furnished with a carrier system, it should carefully study its needs and specify additional requirements deemed necessary.

2.122 Some carrier suppliers can supply disconnect and make busy on voice frequency extension circuits by supplying another carrier group alarm unit at the distant office in parallel with the carrier group alarm unit normally supplied at the carrier equipment. An extra cable pair is required between the point where the VF extension leaves the carrier channel to the distant office. This requirement should be made in Item 2.15 and the overall system described in the addendum to the plans and specifications required in Item 2.107.

2.13 Items 2.16 and 2.17 are self-explanatory. In locating carrier equipment, it should be placed as far as possible from central office power equipment of the static or rotating type. The minimum recommended distance is six feet from such equipment, preferably greater. The reason for this requirement is not only to reduce the

influence from audible type noise interference but more important to reduce the effects of impulse type noise, which cannot be heard but which affects satisfactory data transmission. In the future, data information traffic will increase and the careful location of carrier equipment away from power equipment will help assure satisfactory data transmission. The floor plan should be detailed enough to show existing cable racks so that cable lengths can be determined for contracts requiring installation. Also, if existing equipment racks are to be used, the proposed position for the carrier equipment should be specified. Type and manufacturer of all cable rack and support structures should be specified.

2.14 Item 2.21 gives the purchaser a choice of termination of the entrance cable though which the carrier system(s) will operate.

2.15 In Item 3.1 the 1000 Hz trunk net loss objective will be specified for the various trunk groups involved. The value stated here will be determined from the level diagrams which are specified in Item 3.1 as part of the plans and specifications.

2.151 The level diagram will show the losses through all the facilities which comprise the trunk circuit, even when the carrier equipment provides only a portion of the overall circuit.

2.152 The level diagram will state the transmission loss objective for the toll connecting trunks and/or extended area service trunks.

2.153 The level diagram will show the central office losses used in establishing the transmission loss objective. These will be actual central office losses but when necessary calculated or estimated values can be used.

2.154 The level diagram will show the location of the two-wire test jacks (and mod and demod jacks, if provided) at both ends of the carrier channels and specify the send and receive levels for alignment between these points.

2.155 All hybrids required in connection with all VF circuits being extended from the carrier channels shall be two coil hybrids and not resistance types or not one coil types.

2.156 An example of a level diagram is shown in Figure 3.

2.16 In Item 3.2 the idle channel noise objective will be specified which will be measured at the two-wire test jacks or mod and demod test jacks. The value is specified in dBrnc0 so that in actual measurement the meter reading has to be corrected according to the point at which the noise is measured. Where equipment is to be furnished which will interconnect with connecting company equipment,

it is necessary that both companies agree on noise objectives to be met over the carrier channels. The maximum permissible idle channel noise specified should be coordinated with the limits set in REA Trunk Carrier Specification PE-60.

2.17 In Item 4.0 coordination with other carrier systems is specified. Coordination among carrier systems is a most important part of carrier system application engineering. In many instances there are existing carrier systems in the same cable such as station carriers which have to be considered when other carrier systems are added. Coordination is easily accomplished if carrier of the same frequencies are applied to the same cable. If unlike carrier systems are added, consideration to the coordination of the frequencies has to be given.

2.171 Digital type pulse code modulation carrier systems will coordinate with station carrier systems. All station carrier systems on the REA List of Materials have to comply to a certain frequency standard which limits the top frequency to 136 kHz. The pulse code modulation carrier systems of the "T-1" type have the characteristic that the high frequency bit stream does not contain very much energy at frequencies below 136 kHz. Therefore, the pulse code modulated carrier would not interfere with the station carrier. There is no conflict of station carrier interfering with the pulse code modulated carrier.

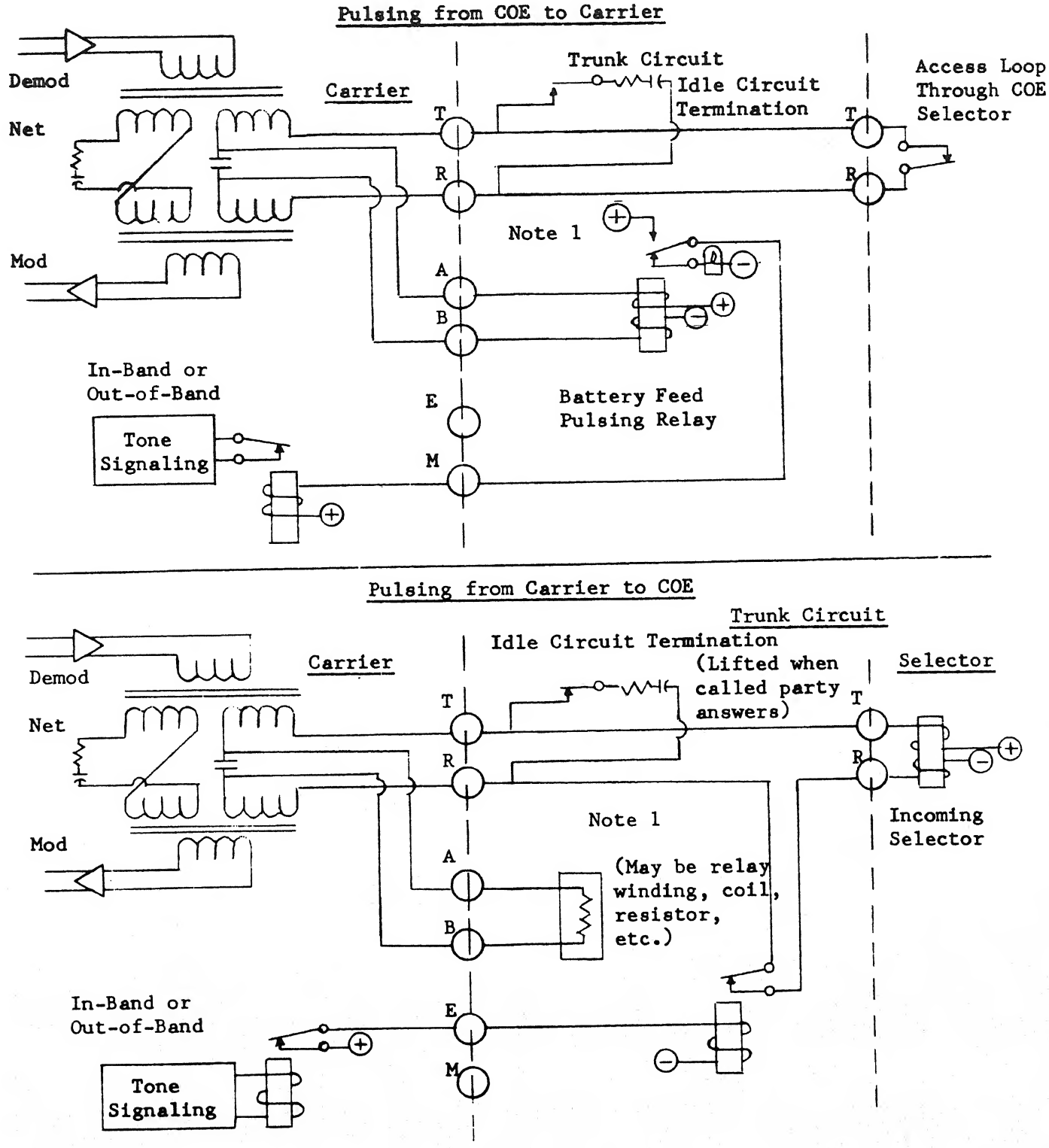
2.172 As indicated above in paragraph 2.0307, the "Carrier System Layout" should show all other carrier systems on the same open wire line or same cable, regardless of how short the exposure may be. It should be the seller's responsibility to discard this information if he so chooses. If the seller is informed of all carrier installed and he does not recognize the possibility of interference, it will be his responsibility to pay for corrective measures.

2.18 In Item 5.0 the outside plant facilities are described. A frequent problem when carrier is actually being installed is that the outside plant facilities may not be as represented in the carrier plans and specifications. Therefore, in Item 5.2 it is specified that if the cable is new construction built under REA Outside Plant Plans and Specifications, insertion loss data at carrier frequencies is available from the outside plant acceptance tests. The outside plant tests are described in REA's standards for "Acceptance Tests and Measurements of Telephone Plant," PC-4. If the cable plant is already existing, in Item 5.2 is specified which party is to make carrier frequency insertion loss measurements--either the telephone company or the carrier supplier at time of installation of the equipment. In Item 5.42 carrier frequency insertion loss measurements for open wire plant over which carrier will operate are not mandatory. But, if the application involves the use of high frequency carrier channels where it is not known if the characteristics of the open wire line are satisfactory for the carrier application (free from absorption peaks and adequate far-end crosstalk loss between systems), then it may be necessary for the telephone company

to make such an investigation before specifying open wire carrier equipment. The data should be a part of the plans and specifications.

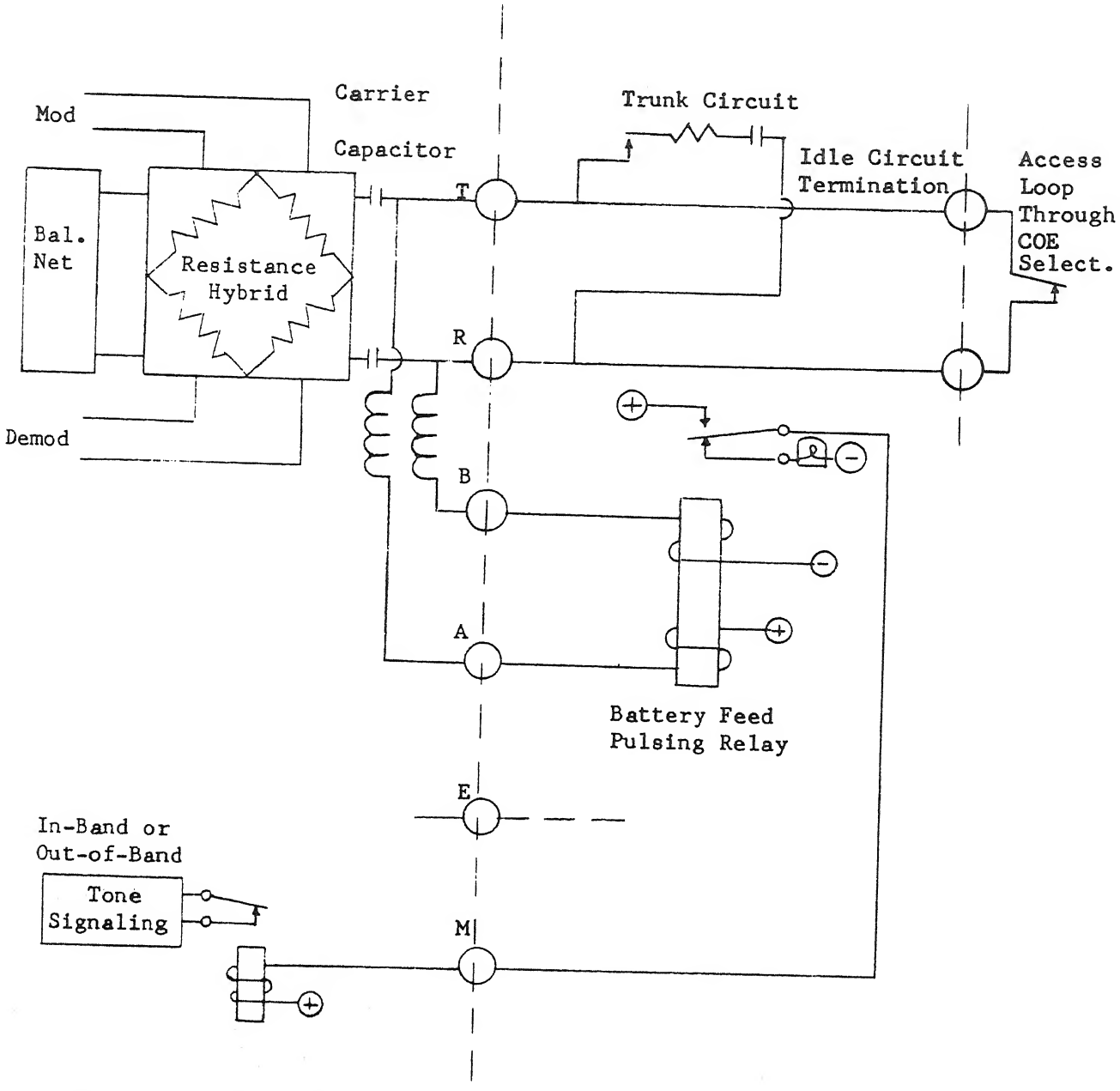
2.19 In Item 6.0 is specified if the telephone company has certain electrical protection requirements for adequate protection of carrier equipment. With respect to cable carrier systems, in some areas, the "by-pass" arrangement of electrical protectors for repeaters has been successfully used where other methods were ineffective in keeping the systems in operation. This is discussed in TE&CM 822, "Electrical Protection of Carrier Equipment." Any particular protection requirements should be specified here unless, of course, the telephone company wishes to rely on recommendations of the carrier seller.

FIGURE 1 - SIMPLIFIED DIAGRAMS OF E&M SIGNALING



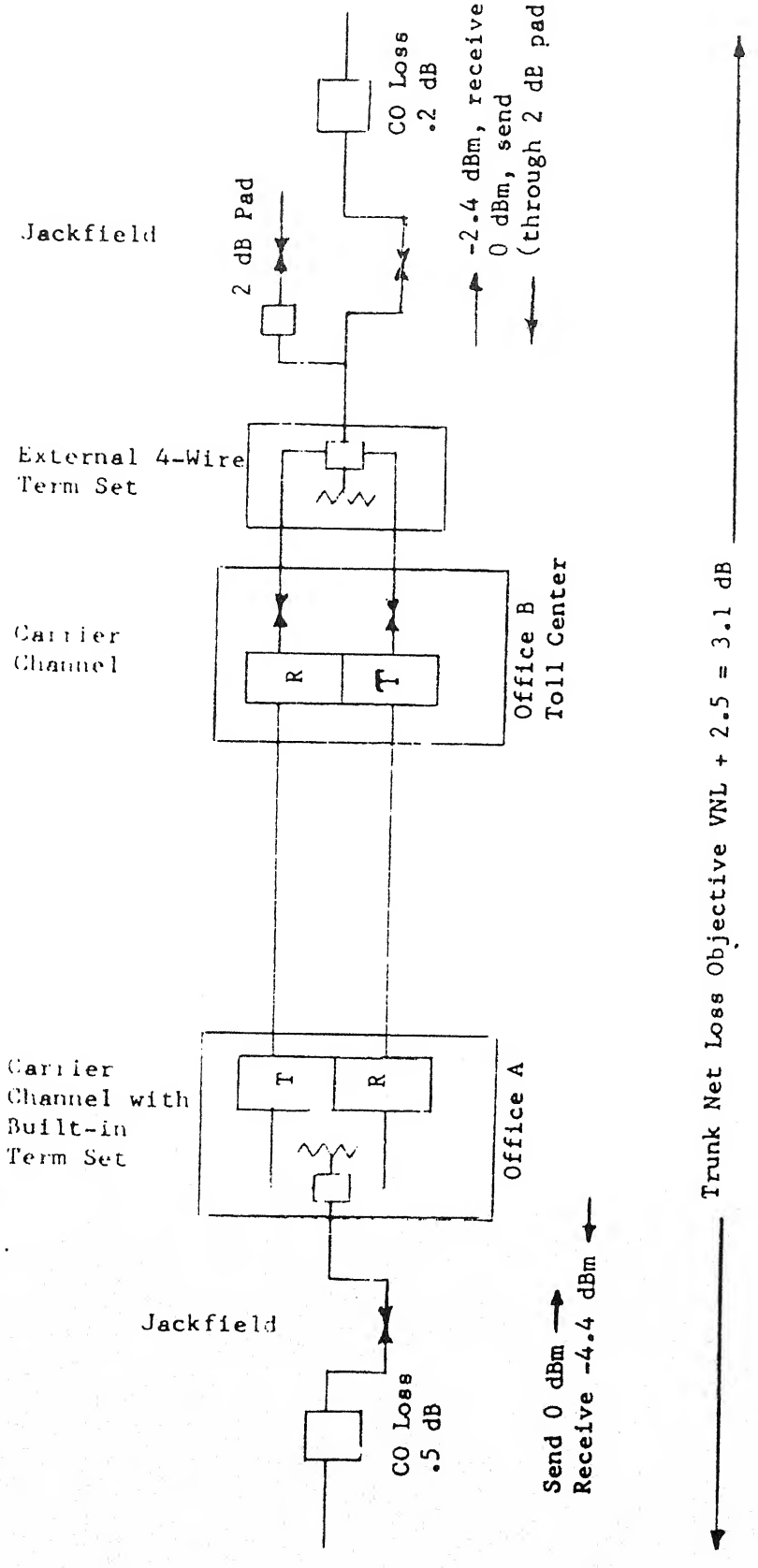
Note 1: This indicates contacts of relays (not shown) that give different switching paths depending on the direction of signaling (carrier to COE or COE to carrier).

FIGURE 2 - PULSING FROM COE TO CARRIER



Derivation of A&B leads from a resistance type hybrid by means of retardation coils connected between T-R and pulsing relay of trunk circuit.

Pulsing from carrier to COE same as in Figure 1. A&B leads derived as shown above.



Type Trunk: Toll Connecting
Trunk Group No: 101A
Project: Baytown Telephone Company

FIGURE 3 - EXAMPLE OF LEVEL DIAGRAM